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New Zealand *Austrophthiracarus* (Acari, Oribatida, Steganacaridae): two new species from the North Island

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Abstract

Two new species of *Austrophthiracarus* (Oribatida: Steganacaridae) from national parks on the North Island of New Zealand are described: *Austrophthiracarus taranaki* **sp. nov.** from moss along tracks in Wilkies Pools, Egmont National Park, Taranaki and *Austrophthiracarus whirinaki* **sp. nov.** from litter in Whirinaki Forest, between Rotorua and Taupo. An updated key to all known species of *Austrophthiracarus* in New Zealand is presented.

Key words: Soil mites, ptyctimous mites, morphology, systematics, Australasian region

Introduction

This work is part of our continuing study on New Zealand ptyctimous mites (Acari, Oribatida) (e.g. Liu & Zhang 2013a, b, c, d, e, 2014a, b, c, d, 2015a, b, c, 2016a, b). In a recent study of oribatid mite material from New Zealand Arthropod Collection, we identified two new species of the genus *Austrophthiracarus* from the North Island of New Zealand.

Austrophthiracarus is the second largest genus of the family Steganacaridae (Niedbala and Liu 2018). It was proposed by Balogh & Mahunka (1978) with *Austrophthiracarus radiatus* from Queensland, Australia as type species. This genus has been well reviewed by Liu & Zhang (2016a). The main generic characters of this genus were summarized by Niedbala (2011). At present, this genus comprises 127 species (Niedbala and Liu 2018) and most of them have been found in the Southern Hemisphere. In New Zealand, the fauna of *Austrophthiracarus* species is still poorly known. Till now, only 16 named species of this genus have been reported (Liu & Wu 2016).

The primary goal of this paper is to describe and illustrate two new species under the names *Austrophthiracarus taranaki* **sp. nov.** and *Austrophthiracarus whirinaki* **sp. nov.** based on adults from the North Island of New Zealand. In addition, an updated key to all species of *Austrophthiracarus* known from New Zealand is provided to facilitate identification.

Material and methods

All specimens were submerged in lactic acid and mounted on temporary cavity slides for measurement and description by using a light microscope equipped with a drawing attachment.

The length of the body was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate, whereas the width of the body refers to the maximum width in dorsal view. Lengths of setae were measured in lateral view. Setal counts for leg segments are given according to the sequence trochanter-femur-genu-tibia-tarsus (famulus included). Formula for leg solenidia is given in parentheses. The unit of measurement is micrometre (µm). Terminology generally follows Niedbala (2000, 2011).

Specimen depositories are cited using the following abbreviations: NZAC—New Zealand Arthropod Collection, Landcare Research, Auckland. NIGA—Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun, China.

Descriptions of new species

Austrophthiracarus taranaki sp. nov.

(Figures 1A–H)

Diagnosis. Entire surface of idiosoma finely punctate; one pair of prodorsal lateral carinae present; median sigillar fields long and bifurcate distally; sensilli short narrow fusiform with pointed head; other prodorsal setae short and fine, nearly similar in length; 16 pairs of notogastral setae present, all stout and sparsely barbed; vestigial setae f_1 positioned posterior to setae h_1 ; two pairs of lyrifissures ia and im present; $h > h-h$; formula of genital setae: 6(4+2):3; setae ad_1 , ad_2 and anal setae stout and sparsely barbed, setae ad_3 rough and thinnest.

Description. *Measurements.* Holotype: Prodorsum: length 315, width 230, height 110, setae: ss 45, ro 30, in 22, le 25, ex 15; notogaster: length 620, width 445, height 460; setae: c_1 130, c_2 125, c_3 110, cp 110, d_1 115, e_1 115, h_1 125, h_3 90, ps_1 125, ps_4 65; ad_1 60, ad_2 55, ad_3 38, an_1 105, an_2 95; genito-aggenital plate 110×165, ano-adanal plate 95×245. Paratypes: Prodorsum: length 305–310, width 225, height 100–103; notogaster: length 600–615, width 430–440, height 450–455.

Integument. Colour dark brown. Entire surface finely punctate.

Prodorsum (Figs 1A–B). Median crista, posterior furrows absent; one pair of lateral carinae present, not reaching sinus; sigillar fields distinct, median field long, bifurcate distally, lateral fields shorter; sensilli (ss) short narrow fusiform with pointed head; other prodorsal setae (in , le , ro and ex) short and fine, nearly similar in length; comparative length: $ss > ro > le > in > ex$, $in-in/ro-ro \approx 2.32$.

Notogaster (Fig. 1A). 16 pairs of notogastral setae present, medium in length ($c_1/c_1-d_1 \approx 0.77$), stout, erect, and sparsely barbed in distal half; additional setae located in ps rows; setae c_1 and c_2 further away from anterior border than setae c_3 vestigial setae f_1 positioned posterior to setae h_1 ; two pairs of lyrifissures ia and im present.

Gnathosoma (Figs 1D–F). Subcapitulum typical of family (Fig. 1D); setae h , m and a simple and smooth; setae h longer than distance between them; adoral seta or_1 apparently flat with barbs; or_{2-3} simple and smooth; palp (Fig. 1E) 4-segmented, with femur and genu fused; palpal setation: 0-2-2-7(1); supracoxal seta simple and smooth; chelicera (Fig. 1F) typical of family.

Ano-genital region (Figs 1A, C). Nine pairs of genital setae (g) arranged with formula: 6(4+2):3; ano-adanal plates each with five setae (ad , an), setae ad_1 and ad_2 stout and sparsely barbed, setae ad_3 rough and thinnest; anal setae sparsely barbed, straight and longer; comparative length: $an_1 > an_2 > ad_1 > ad_2 > ad_3$.

Legs (Figs 1G–H). Setal counts for leg segments: I: 1-4-2(2)-4(1)-19(3); II: 1-3-2(1)-3(1)-12(2), III: 2-2-1(1)-2(1)-10, IV: 2-1-1-2(1)-10; setae d on femora I inserted located near distal ends of articles; setae a'' on tarsi I and setae ft'' on tarsi II straight; setae a'' on tarsi II curved distally; setae s and pv' on tarsi IV present; setae s on tarsi I and II present.

Material examined. Holotype: adult (NZAC, in alcohol, 77/33), New Zealand: TK, Wilkies Pools, Dawson Falls area, Egmont National Park, 1170 m a.s.l., from moss, 21 Feb. 1977, leg. B. M. May. Paratypes: two adults (NIGA, in alcohol, 77/133), same data as holotype.

Type deposition. Holotype specimen is deposited in NZAC. Paratypes are deposited in NIGA.

Etymology. Named after Mt. Taranaki and used as a noun in apposition.

Remarks. This new species is similar to *Austrophthiracarus filiformis* Liu & Chen, 2014 in having one pair of prodorsal lateral carinae present, prodorsal setae short and 16 pairs of fine notogastral setae present, vestigial setae f_1 positioned posterior to setae h_1 , formula of genital setae: 6(4+2):3, ano-adanal plates with five setae, setae d on femora I inserted near distal ends of articles, but can be differentiated by: 1) sensilli short narrow fusiform with pointed head (versus setiform, long and narrow in *A. filiformis*); 2) median sigillar fields bifurcate distally (versus connected but not bifurcate); 3) additional setae located in ps rows (versus in h rows); 4) two pairs of notogastral lyrifissures present (versus four pairs); 5) setae g_{6-9} short, not longer than distance between them (versus longer); 6) adanal setae shorter than anal setae (versus longer than anal setae).

Compared with *Austrophthiracarus vestigijs* Liu & Wu, 2016, this new species is similar by short lamellar and rostral setae, and 16 pairs of notogastral setae present, but differs by the following characters: 1) one pair of prodorsal lateral carinae present (versus absent in *A. vestigijs*); 2) sensilli with pointed end (versus rounded end); 3) interlamellar and exobothridial not vestigial (versus vestigial); 4) setae *cp* situated at level of setae *h*₂ (versus much lower, nearly at level of setae *h*₃); 5) two pairs of notogastral lyrifissures present (versus four pairs); 6) formula of genital setae: 6(4+2):3 (versus 9(4+5):0); 7) ano-adanal plates with five setae (versus six setae); 8) setae *d* on femora I inserted near distal ends of articles (versus remote).

***Austrophthiracarus whirinaki* sp. nov.**

(Figs. 2A–H)

Diagnosis. Entire surface of idiosoma finely punctate; posterior furrows and lateral carinae absent; sensilli short with rounded head; interlamellar setae long, stout and sparsely barbed; lamellar setae vestigial; rostral setae short and spiniform, situated far from anterior margin of rostrum; exobothridial setae short and fine; 15 pairs of notogastral setae stout and sparsely barbed; vestigial setae *f*₁ positioned anterior to setae *h*₁; two pairs of lyrifissures *ia* and *im* present; $h < h-h$; formula of genital setae: 6(4+2):3; setae *ad*₁ and *ad*₂ vestigial, setae *ad*₃ finely barbed.

Description. *Measurements.* Holotype: Prodorsum: length 440, width 250, height 165, setae: *ss* 50, *ro* 82, *in* 185, *ex* 34; notogaster: length 815, width 570, height 600; setae: *c*₁ 120, *c*₂ 100, *c*₃ 95, *cp* 85, *d*₁ 115, *e*₁ 110, *h*₁ 110, *h*₃ 80, *ps*₁ 105, *ps*₄ 69; *ad*₃ 55, *an*₁ 150, *an*₂ 153; genito-aggenital plate 150×200, ano-adanal plate 135×320. Paratypes: Prodorsum: length 410–425, width 235–242, height 160–165; notogaster: length 795–805, width 550–560, height 575–590.

Integument. Colour dark brown. Entire surface finely punctate.

Prodorsum (Figs 2A–B). Median crista, posterior furrows and lateral carinae absent; sigillar fields distinct, median field narrow and short, but longer than lateral fields; sensilli (*ss*) with short, with narrow pedicel and rounded head; interlamellar setae (*in*) long, stout, erect, and sparsely barbed in distal half; lamellar setae (*le*) vestigial; rostral setae (*ro*) spiniform, short, rough and semi-erect, inserted far from anterior margin of rostrum; exobothridial setae (*ex*) short and fine; comparative length: $in > ro > ss > ex$, $in-in/ro-ro \approx 2.08$.

Notogaster (Fig. 2A). 15 pairs of notogastral setae present, medium in length ($c_1/c_1-d_1 \approx 0.54$), stout, erect, and sparsely barbed in distal half; setae *c*₂ further away from anterior border than setae *c*₁ and *c*₃, setae *c*₃ closest; vestigial setae *f*₁ positioned anterior to setae *h*₁; two pairs of lyrifissures *ia* and *im* present.

Gnathosoma (Figs 2D–F). Subcapitulum typical of family (Fig. 2D); setae *h*, *m* and *a* simple and smooth; setae *h* shorter than distance between them; adoral seta *or*₁ apparently flat with barbs; *or*₂₋₃ simple and smooth; palp (Fig. 2E) 4-segmented, with femur and genu fused; palpal setation: 0-2-2-7(1); supracoxal seta simple and smooth; chelicera (Fig. 2F) typical of family.

Ano-genital region (Figs 2A, C). Nine pairs of genital setae (*g*) arranged with formula: 6(4+2):3; ano-adanal plates each with five setae (*ad*, *an*), setae *ad*₁ and *ad*₂ vestigial, setae *ad*₃ short and finely barbed; anal setae sparsely barbed, straight and longer; comparative length: $an_2 > an_1 > ad_3$.

Legs (Figs 2G–H). Setal counts for leg segments: I: 1-4-2(2)-4(1)-17(3); II: 1-3-2(1)-3(1)-12(2), III: 2-2-1(1)-2(1)-10, IV: 2-1-1-2(1)-10; setae *d* on femora I inserted on 1/3 of the length from the anterior part of femora; setae *a*'' on tarsi I and setae *ft*'' on tarsi II straight; setae *a*'' on tarsi II curved distally; setae *s* and *pv*' on tarsi IV present; setae *s* on tarsi I and II present.

Material examined. Holotype: adult (NZAC, in alcohol, 84/67), New Zealand: TO, Whirinaki SF¹, from litter, 12 Sep. 1984, leg. C. Crowe. Paratypes: two adults (NIGA, in alcohol, 84/67), same data as holotype.

Type deposition. Holotype specimen is deposited in NZAC. Paratypes are deposited in NIGA.

1. SF = State Forest. This New Zealand forest is one of the prehistoric rainforests in the world and now part of the Whirinaki Te Pua-a-Tāne Conservation Park.

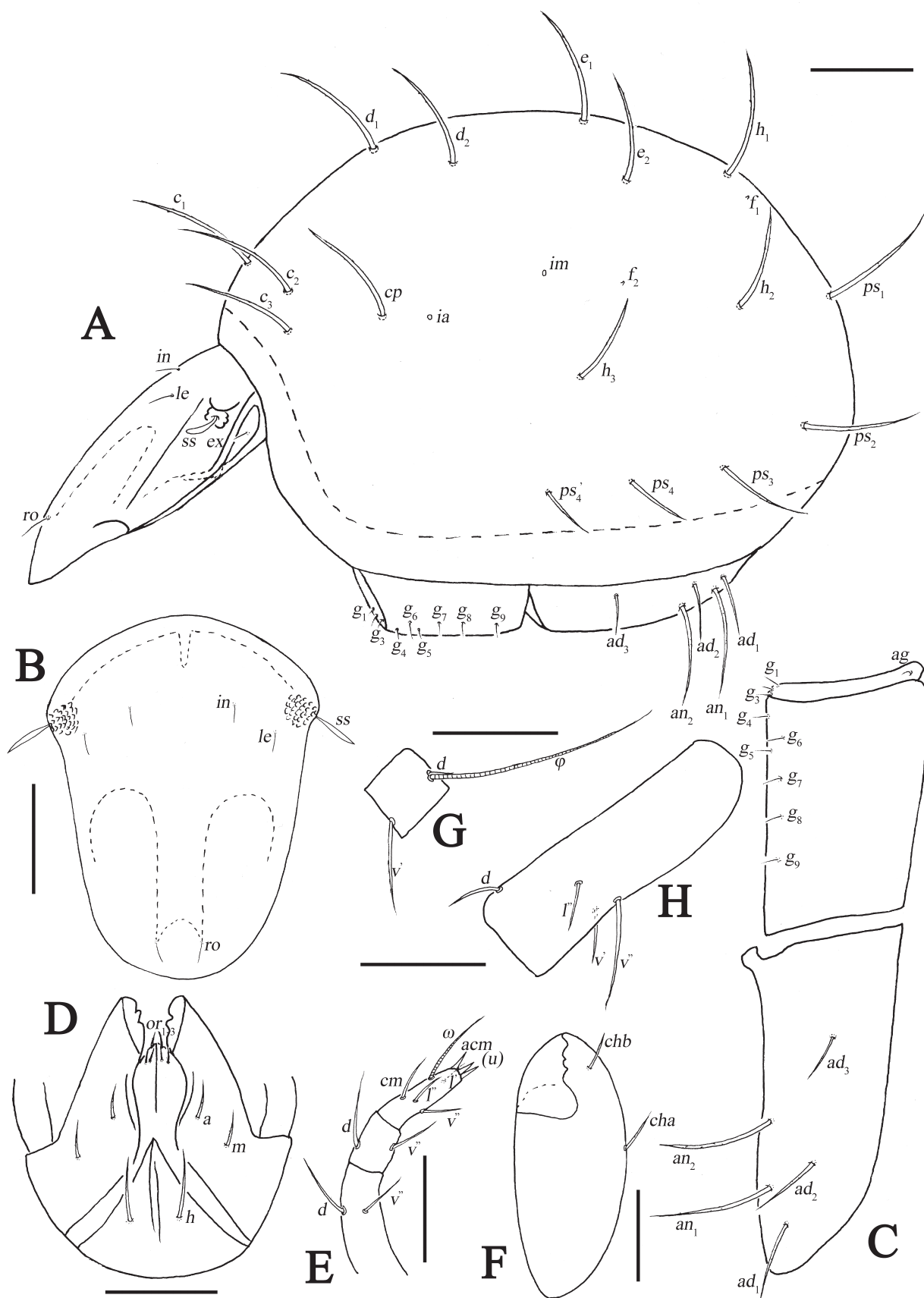


FIGURE 1. *Austrophthiracarus taranaki* sp. nov.: A, lateral view of body (legs removed); B, prodorsum, dorsal view; C, left side of ventral plate; D, subcapitulum, palpi removed; E, palp, antiaxial view; F, chelicera, antiaxial view; G, tibia IV; H, femur I. Scale bars: A–C=100 μ m; D–H=50 μ m.

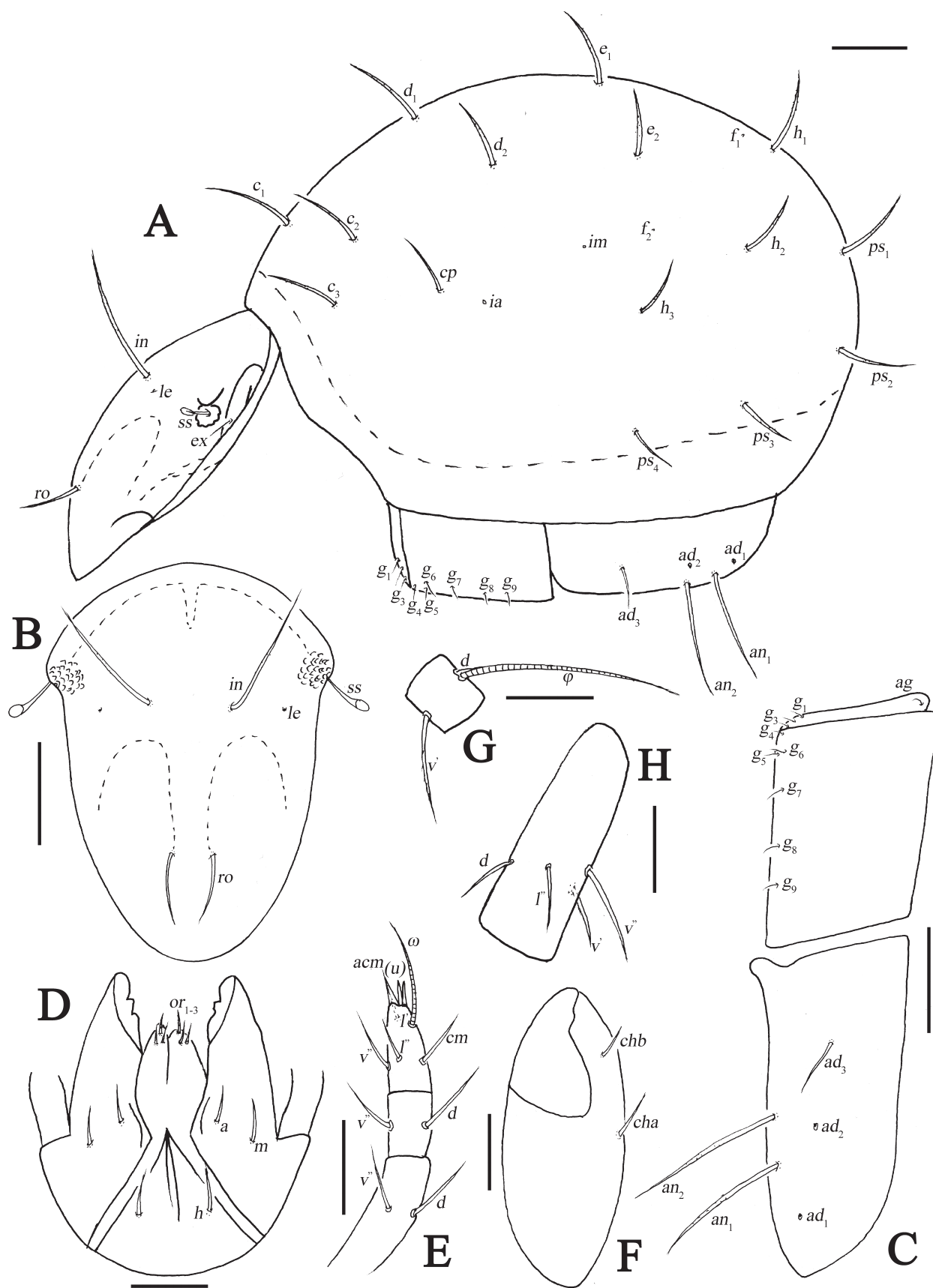


FIGURE 2. *Austrophthiracarus whirinaki* sp. nov.: A, lateral view of body (legs removed); B, prodorsum, dorsal view; C, left side of ventral plate; D, subcapitulum, palpi removed; E, palp, antiaxial view; F, chelicera, antiaxial view; G, tibia IV; H, femur I. Scale bars: A–C=100 µm; D–H=50 µm.

Etymology. Named after Whirinaki Forest and used as a noun in apposition.

Remarks. This new species is similar to *Austrophthiracarus nicoleti* (Niedbala, 1987) in having similar shape of sensilli, lamellar setae vestigial, interlamellar setae long and thick, lateral carinae of prodorsum absent, 15 pairs of notogastral setae, but can be distinguished by the following characters: 1) surface of idiosoma finely punctate (versus surface of prodorsum and notogaster with foveoles in *A. nicoleti*); 2) distance between setae ps_3 and ps_4 similar to that between setae ps_2 and ps_3 (versus more than twice longer than that between ps_2 and ps_3); 3) vestigial setae f_1 positioned anterior to setae h_1 (versus posterior to setae h_1); 4) two pairs of notogastral lyrifissures present (versus four pairs); 5) formula of genital setae: 6(4+2):3 (versus 5(4+1):4); 6) setae ad_1 and ad_2 vestigial (versus not vestigial); 7) setae d on femora I not forked distally (versus forked).

This new species is also similar to *Austrophthiracarus latior* (Niedbala, 1982), *Austrophthiracarus tragardhi* (Niedbala, 1987), *Austrophthiracarus retrorsus* Niedbala, 2003 and *Austrophthiracarus ridiculus* (Mahunka, 1982) in sharing similar shape of sensilli, long and thick interlamellar setae (interlamellar setae more than six times longer than lamellar setae), 15 pairs of notogastral setae, median crista absent, but can be distinguished by the following combination of features: lamellar setae and setae ad_1 and ad_2 vestigial (versus not vestigial in these four species); surface of idiosoma finely punctate (versus surface of notogaster covered with weak concavities in *A. retrorsus*, margins of notogaster covered with concavities in *A. ridiculus*); posterior furrows on prodorsum absent (versus present in *A. ridiculus*); prodorsal lateral carinae absent (versus present in *A. latior* and *A. ridiculus*); head of sensilli smooth (versus covered with spines in *A. latior*); vestigial setae f_1 positioned anterior to setae h_1 (versus posterior to setae h_1 in *A. latior* and *A. tragardhi*); two pairs of notogastral lyrifissures present (versus four pairs in *A. retrorsus* and *A. ridiculus*); formula of genital setae: 6(4+2):3 (versus 9(4+5):0 in *A. latior* and *A. tragardhi*); ano-adanal plates with five setae (versus six setae in *A. tragardhi*, *A. retrorsus* and *A. ridiculus*); $h < h-h$ (versus $h = h-h$ in *A. latior* and *A. ridiculus*, $h > h-h$ in *A. tragardhi*).

Compared with *Austrophthiracarus feideri* (Balogh & Csiszar, 1963), they have similar shape of setae ad_1 and ad_2 and sensilli. However, the new species differs from *A. feideri* by 1) surface of idiosoma finely punctate (versus prodorsum foveolate in *A. feideri*); 2) lamellar setae vestigial (versus not vestigial); 3) dorsal notogastral setae stout and not much longer than other setae (versus dorsal setae flagellate distally and much longer than others); 4) formula of genital setae: 6(4+2):3 (versus 5(4+1):4); 5) setae ad_1 and ad_2 vestigial (versus minute); 6) anal setae not flagellate distally (versus flagellate distally).

Key to species of *Austrophthiracarus* reported from New Zealand

- 1 Sensilli long, setiform, without distinctly swollen head; posterior part of notogaster with peculiar structure of protuberance. 2
- Sensilli short, club-like or fusiform; posterior part of notogaster without peculiar structure of protuberance. 3
- 2 Protuberance on notogaster large, rounded and tail-like, with four pairs of setae; formula of genital setae: 9(4+5):0. *A. hiore* Liu & Zhang, 2014a
- Protuberance on notogaster much smaller, and irregular in shape, with two pairs of setae; formula of genital setae: 7(4+3):0. *A. daimonios* Niedbala, 2000
- 3 Notogaster with 15 pairs of setae 4
- Notogaster with more than 15 pairs of setae. 7
- 4 Interlamellar setae short and fine *A. tawhai* Liu & Zhang, 2013c
- Interlamellar setae long and thick 5
- 5 Setae ad_1 and ad_2 not vestigial. *A. bah* Liu & Zhang, 2015a
- Setae ad_1 and ad_2 vestigial. 6
- 6 Lamellar setae well developed; $c_1 > c_1-d_1$ *A. waitere* Liu & Zhang, 2015a
- Lamellar setae vestigial; $c_1 < c_1-d_1$ *A. whirinaki* sp. nov.
- 7 All notogastral setae minute and fine *A. karioi* Liu & Zhang, 2014b
- All notogastral setae long and thick 8
- 8 20 or more pairs of notogastral setae present 9
- Fewer than 20 pairs of notogastral setae present. 11
- 9 Interlamellar setae more than three times as long as lamellar setae; three pairs of lyrifissures present. *A. neotrichus* (Wallwork, 1966)
- Interlamellar setae less than twice as long as lamellar setae; two pairs of lyrifissures present 10
- 10 Exobothridial setae vestigial; 21 pairs of notogastral setae present *A. notoporus* Liu & Zhang, 2014b
- Exobothridial setae not vestigial; 20 pairs of notogastral setae present *A. matuku* Liu & Zhang, 2014b

11	Fewer than 19 pairs of notogastral setae present	12
-	19 pairs of notogastral setae present	15
12	16 pairs of notogastral setae present	13
-	18 pairs of notogastral setae present	14
13	Interlamellar setae vestigial; sensilli broad fusiform with rounded head	<i>vestigius</i> Liu & Wu, 2016
-	Interlamellar setae not vestigial; sensilli narrow fusiform with pointed head	<i>A. taranaki</i> sp. nov.
14	Interlamellar setae not vestigial; three pairs of lyrifissures present	<i>A. aureus</i> Niedbala, 2000
-	Interlamellar setae vestigial; two pairs of lyrifissures present	<i>A. pulchellus</i> Niedbala, 1993
15	Setae <i>ad</i> ₃ and <i>ad</i> ₃ ' minute and fine; exobothridial setae not vestigial	16
-	Setae <i>ad</i> ₃ and <i>ad</i> ₃ ' long and thick; exobothridial setae vestigial	17
16	Interlamellar setae vestigial; two pairs of lyrifissures <i>ia</i> and <i>im</i> present	<i>A. cronadun</i> Liu & Zhang, 2013c
-	Interlamellar setae not vestigial; three pairs of lyrifissures <i>ia</i> , <i>im</i> and <i>ips</i> present	<i>A. paracronadun</i> Liu & Wu, 2016
17	Setae <i>h</i> of subcapitulum vestigial	<i>A. neominatus</i> Liu & Wu, 2016
-	Setae <i>h</i> of subcapitulum not vestigial	<i>A. kirikiri</i> Liu & Zhang, 2015a

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